

BioWaRe

**Clean-Energy Recovery from
Biomass Waste & Residues**

Dr. Lourdes Armesto

CIEMAT, Fossil Fuel Department (ES)

Dipl.-Ing. Marius Hackel

Engler-Bunte-Institut, Universität Karlsruhe (DE)

Project-Nº: NNE-2001-00078



**BIO-ENERGY
ENLARGED PERSPECTIVES**

Budapest ,16-17 October 2003

Motivation

- **Energy recovery from biomass waste**
- **Combination of a dry flue gas cleaning and particle removal**
- **Abatement of SO₂, HCl, NO_x and fly ash from biomass combustion**
- **Gas Cleaning by combination of simultaneous sorbent addition and catalytic conversion**



Olive Residues



Leather Waste

Motivation

Overview on flue gas concentrations obtained

| | Olive/Coal Residues | Leather Waste |
|--|------------------------|------------------|
| N (wt %) | 0.7 | 12.2 |
| Cr (wt%) | - | 2.5 |
| NO_x (mg/m^3) _{NTP} | 400 - 700 | 2000 - 2300 |
| SO_2 (mg/m^3) _{NTP} | 800 - 1050 | 2500 - 3000 |

This results in:

- **Environmentally friendly use of biomass waste**
- **Enhanced NO_x removal (>20 % NO_x removal than non-catalytic cleaning step)**
- **Avoidance of waste water in flue gas treatment**

Objectives of the project

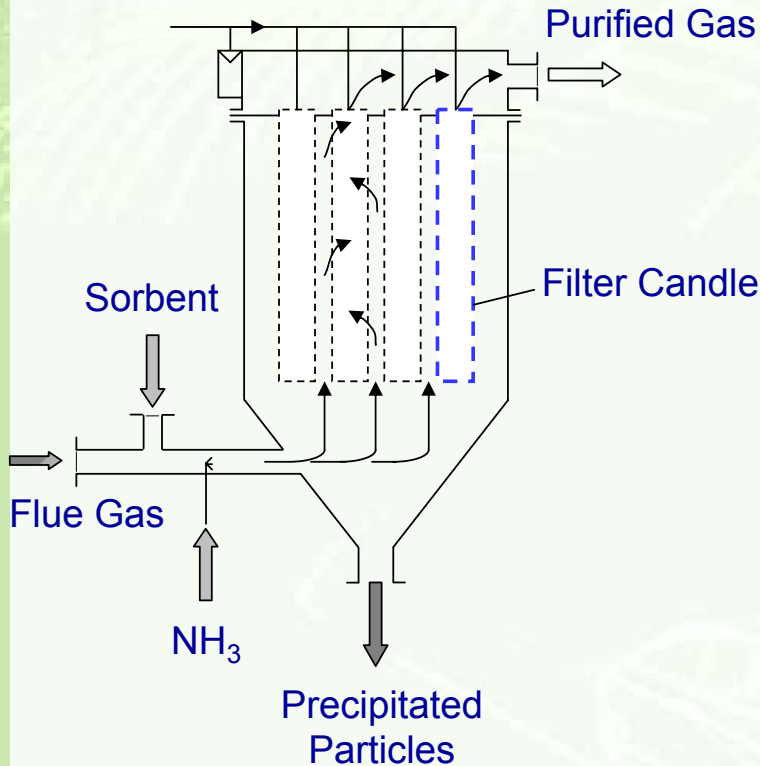
- **Development and construction of a filter house
(in bypass to a 3.5 MW_{th} fluidised bed biomass combustion)**
- **Definition of filtration boundaries for different fuels**
- **Development of a rigid ceramic filter coated with SCR-
DeNO_x catalyst**
- **Adjustment of filtration cycles to meet both**
 - **Best sorption behaviour and**
 - **Catalytic efficiencies on catalytic filtration system**
- **Development of design fundamentals for combined dry gas
cleaning**

Project partners

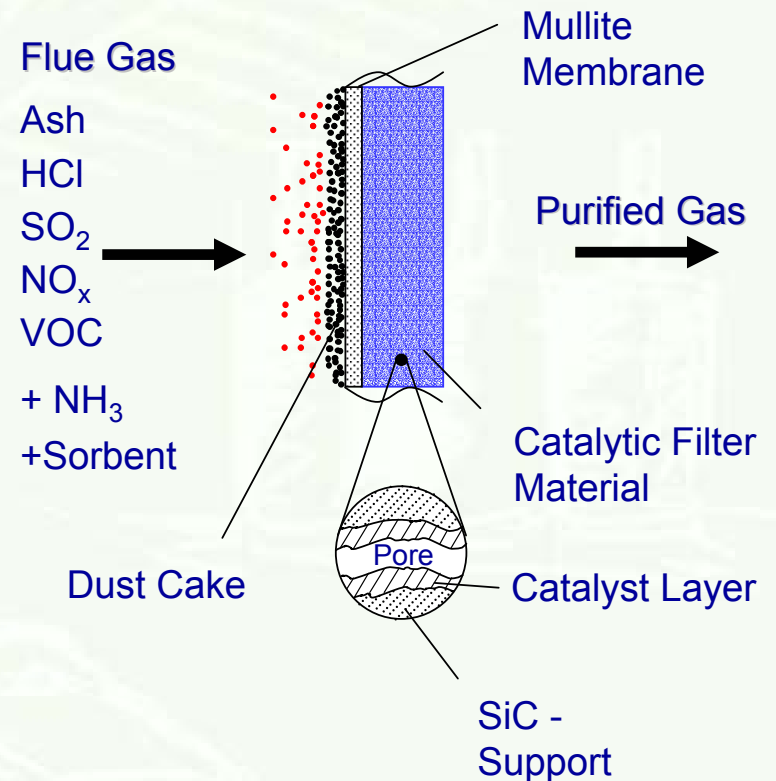
- **CIEMAT (Energy research and environmental technology), Spain**
- **Conversion and Resource Evaluation Ltd., United Kingdom**
- **Universität Karlsruhe (EBI), Germany**
- **Universität Karlsruhe (MVM), Germany**
- **Pall-Schumacher GmbH, Germany**
- **Solvay S.A., Belgium**
- **INESCOP (Association for investigations of leather industry), Spain**

Innovation

Industrial Application

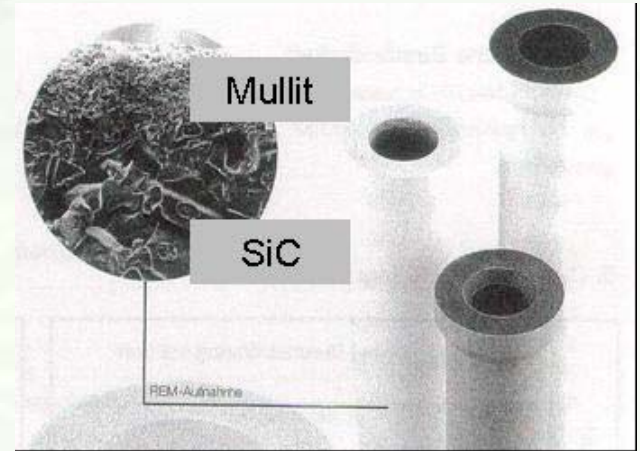


Filtration, Separation, Catalytic Conversion



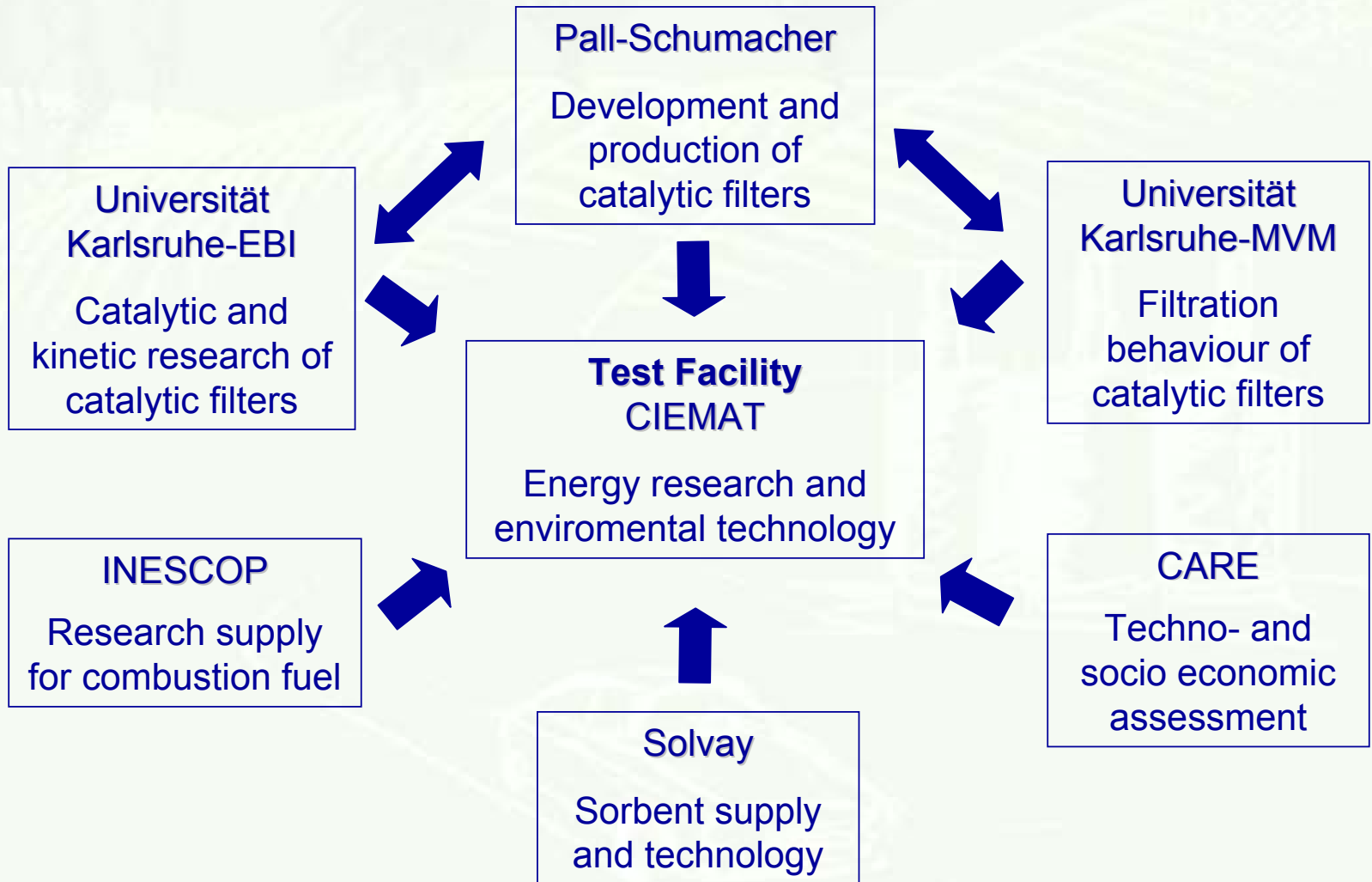
Innovation

Advantages to combined gas cleaning related to the ComFil Project



- **SiC material coated with mullite membrane**
 - ➔ **Protection against poisoning of catalytic layer**
 - **SiC has:**
 - **High heat conductivity**
 - **Thermal shock resistance****compared to fibric filter**
- ➔ **Tailored catalytic filter economically and ecologically interesting for small and middle sized biomass power plants**

Scheme of the work project



Work packages/Actual status

WP

**Filterhouse engineering
(Test facility, Spain)**



Work packages/Actual status

WP

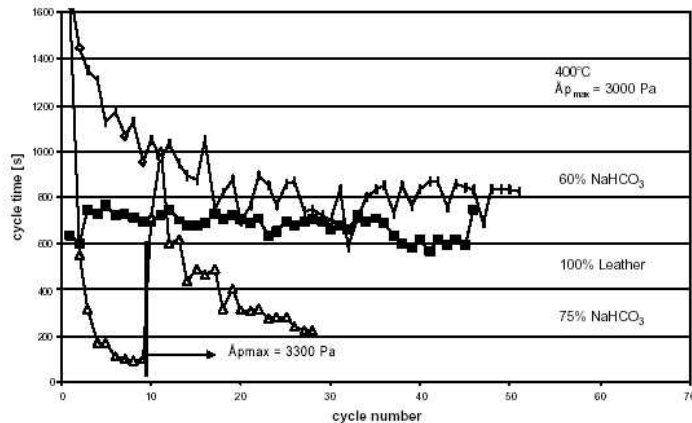
**Filtration tests
with filter disks
(Universität
Karlsruhe,
Germany)**



High-temperature-filtration reactor

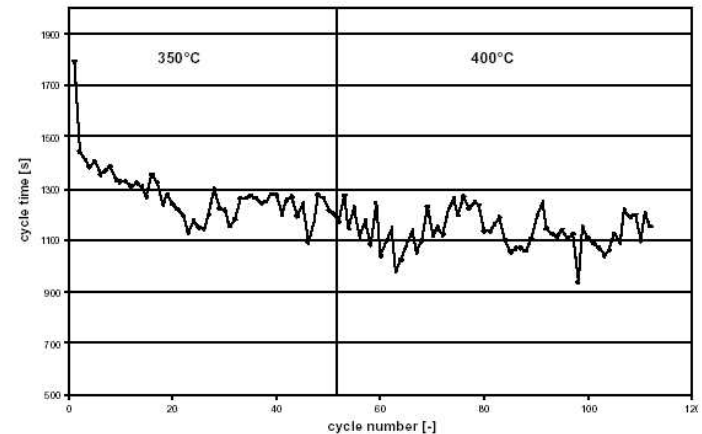
Filtration tests

Leather waste



(400°C, 8 bar tank pressure)

Coal/Olive oil residues



(8 bar tank pressure)

- **Eventual filtration difficulties with mixtures from leather waste and sorbent at 400 °C, measured at a bench-scale rig**
- **No filtration problems from mixtures of ash from coal/olive residues**

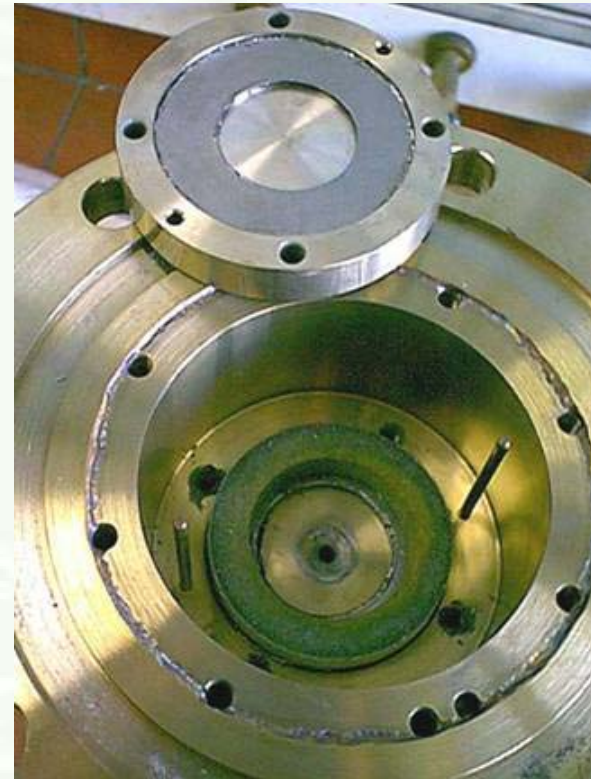
➔ **Optimisation of temperature according to catalytic SCR activity (250 - 300 °C)**

Work packages/Actual status

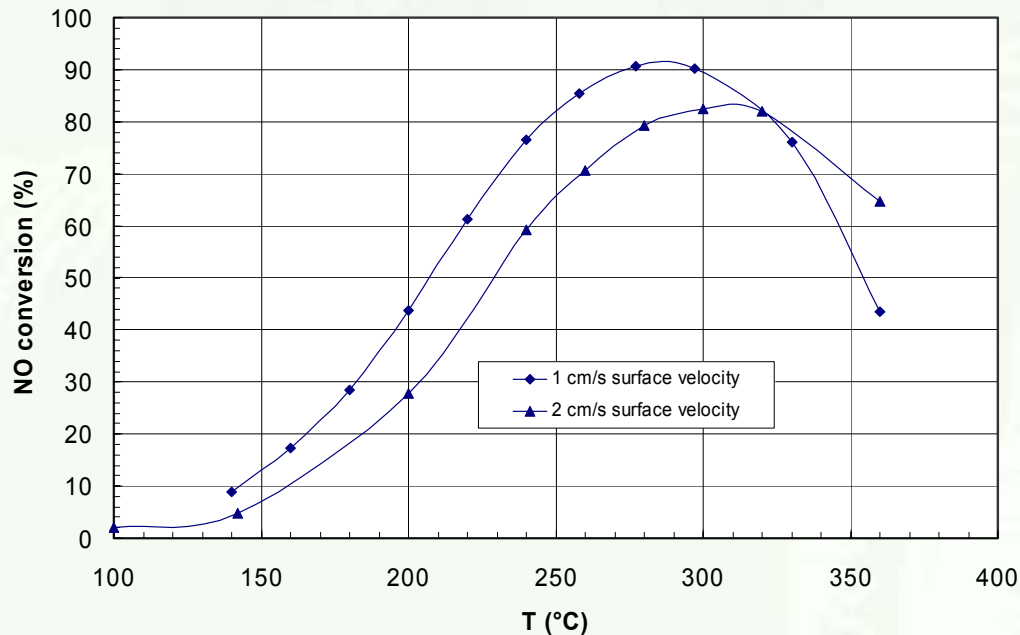


WP

**SCR laboratory research
(Universität Karlsruhe,
Germany)**



SCR laboratory research



- **80 - 90 % NO Conversion measured on a catalytic filter segment in a lab-scale reactor**
- **Scale-up of the filter candle to commercial size is in progress**
- **Preliminary tests of the test facility with the new filterhouse are in progress**

Thank you for your attention !